TABLE II.2 Launch, Orbit, and Instrument Specifications for Missions Recommended to NASA

Decadal Survey Mission	Mission Description	Orbit[a]	Instruments	Rough Cost Estimate (FY 06 $million)
2010–2013				
CLARREO (NASA portion)	Solar and Earth radiation; spectrally resolved forcing and response of the climate system	LEO, Precessing	Absolute, spectrally resolved interferometer	200
SMAP	Soil moisture and freeze-thaw for weather and water cycle processes	LEO, SSO	L-band radar L-band radiometer	300
ICESat-II	Ice sheet height changes for climate change diagnosis	LEO, Non-SSO	Laser altimeter	300
DESDynI	Surface and ice sheet deformation for understanding natural hazards and climate; vegetation structure for ecosystem health	LEO, SSO	L-band InSAR Laser altimeter	700

NOTE: Missions are listed by cost. Colors denote mission cost categories as estimated by the committee. Pink, green, and blue shading indicates large-cost ($600 million to $900 million), medium-cost ($300 million to $600 million), and small-cost (<$300 million) missions, respectively.

[a]LEO, low Earth orbit; SSO, Sun-synchronous orbit.

Source: http://books.nap.edu/openbook.php?record_id=11820&page=81

The background information on these missions, also taken from the decadal survey, is available on page 4.

TABLE II.2 Launch, Orbit, and Instrument Specifications for Missions Recommended to NASA

Decadal Survey Mission	Mission Description	Orbit[a]	Instruments	Rough Cost Estimate (FY 06 $million)
2013–2016				
HyspIRI	Land surface composition for agriculture and mineral characterization; vegetation types for ecosystem health	LEO, SSO	Hyperspectral spectrometer	300
ASCENDS	Day/night, all-latitude, all-season CO_2 column integrals for climate emissions	LEO, SSO	Multifrequency laser	400
SWOT	Ocean, lake, and river water levels for ocean and inland water dynamics	LEO, SSO	Ka- or Ku-band radar Ku-band altimeter Microwave radiometer	450
GEO-CAPE	Atmospheric gas columns for air quality forecasts; ocean color for coastal ecosystem health and climate emissions	GEO	High-spatial-resolution hyperspectral spectrometer Low-spatial-resolution imaging spectrometer IR correlation radiometer	550
ACE	Aerosol and cloud profiles for climate and water cycle; ocean color for open ocean biogeochemistry	LEO, SSO	Backscatter lidar Multiangle polarimeter Doppler radar	800

NOTE: Missions are listed by cost. Colors denote mission cost categories as estimated by the committee. Pink, green, and blue shading indicates large-cost ($600 million to $900 million), medium-cost ($300 million to $600 million), and small-cost (<$300 million) missions, respectively.

[a]LEO, low Earth orbit; SSO, Sun-synchronous orbit; GEO, geostationary Earth orbit.

Source: http://books.nap.edu/openbook.php?record_id=11820&page=81

TABLE II.2 Launch, Orbit, and Instrument Specifications for Missions Recommended to NASA

Decadal Survey Mission	**Mission Description**	**Orbit**[a]	**Instruments**	**Rough Cost Estimate (FY 06 $million)**
2016–2020				
LIST	Land surface topography for landslide hazards and water runoff	LEO, SSO	Laser altimeter	300
PATH	High-frequency, all-weather temperature and humidity soundings for weather forecasting and sea-surface temperature[b]	GEO	Microwave array spectrometer	450
GRACE-II	High-temporal-resolution gravity fields for tracking large-scale water movement	LEO, SSO	Microwave or laser ranging system	450
SCLP	Snow accumulation for freshwater availability	LEO, SSO	Ku- and X-band radars K- and Ka-band radiometers	500
GACM	Ozone and related gases for intercontinental air quality and stratospheric ozone layer prediction	LEO, SSO	UV spectrometer IR spectrometer Microwave limb sounder	600
3D-Winds (Demo)	Tropospheric winds for weather forecasting and pollution transport	LEO, SSO	Doppler lidar	650

NOTE: Missions are listed by cost. Colors denote mission cost categories as estimated by the committee. Pink, green, and blue shading indicates large-cost ($600 million to $900 million), medium-cost ($300 million to $600 million), and small-cost (<$300 million) missions, respectively.

[a] LEO, low Earth orbit; SSO, Sun-synchronous orbit; GEO, geostationary Earth orbit.

[b] Cloud-independent, high-temporal-resolution, lower-accuracy sea-surface temperature measurement to complement, not replace, global operational high-accuracy sea-surface temperature measurement.

Source: http://books.nap.edu/openbook.php?record_id=11820&page=81

CLARREO – Climate Absolute Radiance and Refractivity Observatory (http://books.nap.edu/openbook.php?record_id=11820&page=93)
Background: Climate is affected by the long-term balance between the solar irradiance absorbed by the Earth-ocean-atmosphere system and the IR radiation exchanged within that system and emitted to space. Thus, key observations include incident and reflected solar irradiance and the spectrally resolved IR radiance emitted to space that carries the spectral signature of IR climate forcing and the resulting response of that climate system. Given the recognized imperative to develop long-term, high-accuracy time series with global coverage of critical climate variables, CLARREO addresses the objective of establishing global, highly accurate, long-term climate records that are tied to international standards maintained in the United States by the National Institute of Standards and Technology (NIST). In addition, to achieve societal objectives that require a long-term climate record, it is essential that the accuracy of the core benchmark observations be verified against absolute standards on-orbit by fundamentally independent methods.

SMAP – Soil Moisture Active/Passive Mission (http://books.nap.edu/openbook.php?record_id=11820&page=131)
Background: Global mapping of soil moisture and its freeze-thaw state at high resolution has long been of interest because these variables link the terrestrial water, energy, and carbon cycle. Such measurements also have important applications in predicting natural hazards, such as severe rainfall, floods, and droughts. The spatial variations in soil-moisture fields are determined by precipitation and radiation forcing, vegetation distribution, soil-texture heterogeneity, and topographic redistribution processes. The spatial variations lead to the need for high-resolution soil-moisture mapping (Entekhabi et al., 1999). Numerous airborne and tower-based field experiments have shown that low-frequency L-band microwave measurements are reliable indicators of soil-moisture changes across the landscape. Only by combining high-resolution active radar and high-accuracy passive radiometer L-band measurements is it possible to produce data that meet the science and application requirements. The proposed SMAP mission builds on the risk-reduction performed for the AO-3 ESSP called the Hydrosphere State (Hydros) mission (Entekhabi et al., 2004). The SMAP radar makes overlapping measurements, which can be processed to yield resolution enhancement and 1- to 3-km resolution mapped data. The SMAP radar and radiometer share a large deployable light-weight mesh reflector that is spun to make conical scans across a wide (1,000-km) swath. This measurement approach allows global mapping at 3- to 10-km resolution with 2- to 3-day revisit.

ICESat-II (http://books.nap.edu/openbook.php?record_id=11820&page=116 and http://books.nap.edu/openbook.php?record_id=11820&page=117)
Background: Space-borne lidar is a demonstrated technology for obtaining highly accurate topographic measurements of glaciers, ice sheets, and sea ice. Repeated observations of the polar ice caps by NASA'sICESat system are documenting decreases in ice sheet volume. Data acquired over sea ice is proving sufficiently accurate to allow making the first basinwide estimates of sea ice thickness. The technology as demonstrated so far on aircraft also can be used to measure vegetation canopy depth, which can be used as an estimator of biomass. ICESat-II is designed as a follow-on to the successful ICESat mission and would carry a highly accurate lidar instrument for repeat topographic mapping.

DESDnyI – Deformation, Ecosystem Structure, and Dynamics of Ice (http://books.nap.edu/openbook.php?record_id=11820&page=97)
Background: Earth's surface and vegetation cover change on a wide range of time scales. Measuring the changes globally from satellites would enable breakthrough science with important applications to society. Fluid extraction or injection into subterranean reservoirs results in deformation of Earth's surface. Monitoring the deformation from space provides information important for managing hydrocarbons, CO_2, and water resources. Natural hazards—earthquakes, volcanos, and landslides—cause thousands of deaths and the loss of billions of dollars each year. They leave a signature surface-deformation signal; measuring the deformation before and after the events leads to better risk management and understanding of the underlying processes. Climate change affects and is affected by changes in the carbon inventories of forests and other vegetation types. Changes in those land-cover inventories can be measured globally. Socioeconomic risks are related to the dynamics of the great polar ice sheets, which affect ocean circulation and the water cycle and drive sea-level rise and fall. Those processes are quantifiable globally, often uniquely, through space-based observations of changes of the surface and overlying biomass cover.